MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

TCV3151 – COMPUTER VISION

(All sections / Groups)

23 OCTOBER 2017
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

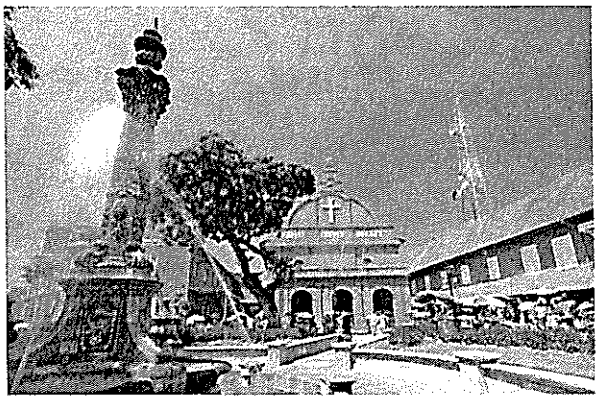
1. This question paper consists of 8 pages with 5 questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers in the answer booklet provided.

QUESTION 1

(a) Describe the fundamental processes involved in a computer vision system. Use a diagram to illustrate how the different processes relate to each other. [3 marks]

(b) Suppose an observer is looking at the Petronas Twin Towers, a 452 meter twin skyscrapers in Kuala Lumpur. What is the size of the retinal image that will be reflected in the area of the observer's fovea given that the observer is standing 800 meter away from the tower? The distance between the focal center of the lens and the retina is approximately 14 millimetre. [1 mark]

(c) Given a digitized image of the Melaka Christ Church with a resolution of 1600×1200.

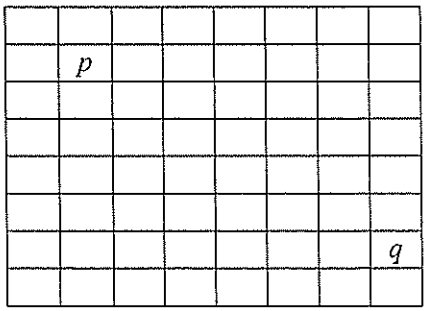


What effects will you observe if you:

(i) Reduce the sampling rate by half? [2 marks]

(ii) Reduce the quantization level by half? [2 marks]

(d) Consider an 8×8 image with two points at pixel coordinates $p = (2,2)$ and $q = (7,8)$, specifying the row and column coordinates, respectively. Compute the distance between p and q using (i) City-block distance, and (ii) Chessboard distance. [2 marks]



Continued .....

QUESTION 2

(a) Fill in the blanks with the correct answers.

(i) The transition between continuous values of the image function and its digital equivalent is called _____.
(ii) Unsharp masking is a _____ filtering technique.
(iii) In _____ image we notice that the components of histogram are concentrated on the lower side on intensity scale.
(iv) _____ involves reversing the intensity levels of an image.

[4 marks]

(b) Consider the original image depicted in Figure 2.1. Which operation could have been applied to obtain the image shown in Figure 2.2? Explain your answer.

Figure 2.1

Figure 2.2

[2 marks]

(c) The diagram illustrated in Figure 2.3 represents the original low-contrast image, with its corresponding histogram shown in Figure 2.4.

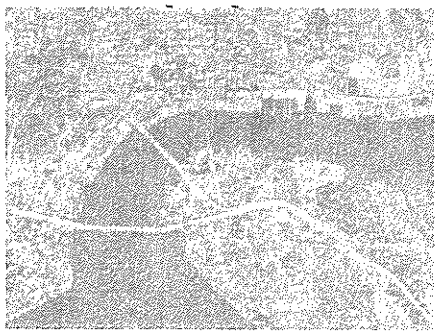


Figure 2.3

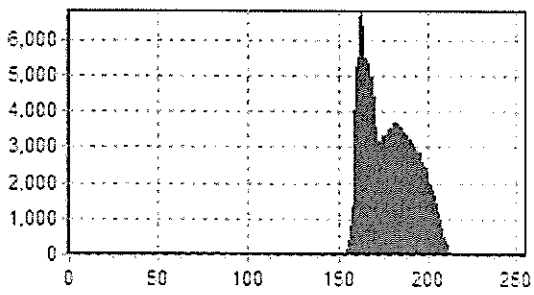


Figure 2.4

Continued .....

Which will be the output of the image if the transformation shown in Figure 2.5 is applied on the original image? Use the results given in Figure 2.6 to Figure 2.7 to explain whether it is (or is not) the correct output.

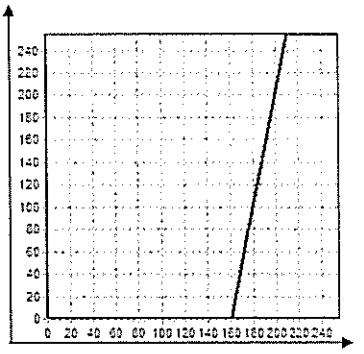


Figure 2.5

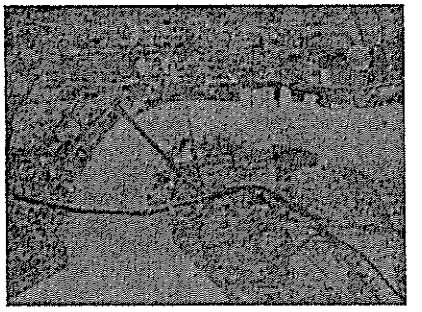


Figure 2.6

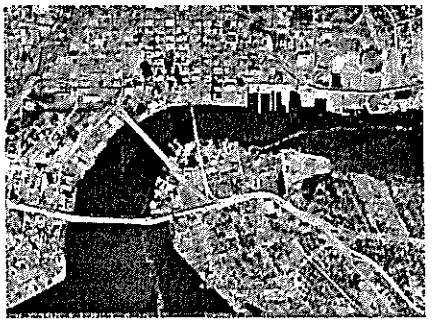


Figure 2.7

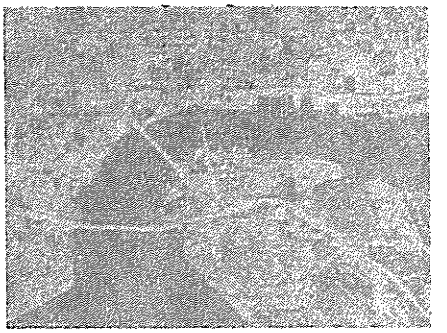


Figure 2.8

[4 marks]

Continued .....

QUESTION 3

(a) Consider the image below which contains an uneven illumination gradient. You are required to segment the texts from the background.

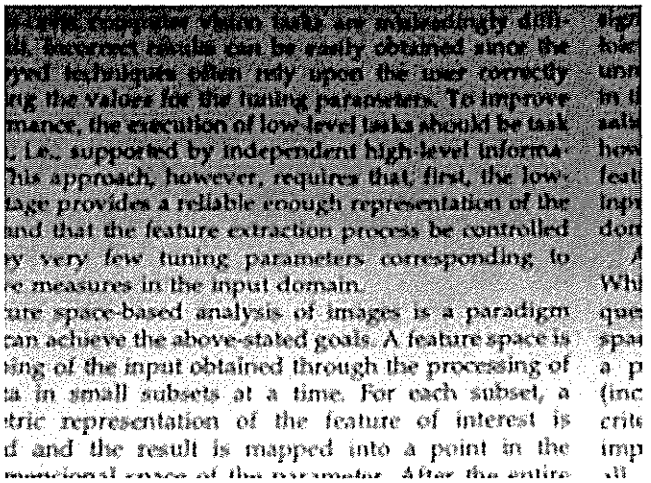


Figure 3.1

(i) Sketch the histogram of the image and explain the challenge related to choosing a suitable threshold for this problem. [2 marks]

(ii) Propose a suitable method that can be used to segment the texts effectively from the background. [2 marks]

(b) A 3-bit image of size 4-by-4 is shown in Figure 3.2.

4	0	1	3
2	4	2	2
0	1	0	1
2	1	0	2

Figure 3.2

(i) Apply average filter on the image using a 3 × 3 sampling window. Extend the border values outside with values at the boundary. [2 marks]

(ii) Apply median filter on the image using a 3 × 3 sampling window. Extend the border values outside with zeros. [2 marks]

Continued .....

(c) Figure 3.3 depicts the original image, while Figure 3.4 and Figure 3.5 show the results of applying Sobel and Roberts operators, respectively, on the image. In your opinion, how does the Sobel operator compare with the Roberts operator in terms of speed, edge detection, and noise suppression?

[2 marks]

Figure 3.3

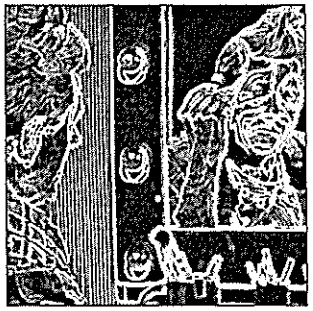


Figure 3.4

Figure 3.5

Continued .....

QUESTION 4

(a) What is image segmentation? Why is it important for an automated image recognition system?

[2 marks]

(b) Consider the following bitstream:

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1

(i) Represent the bitstream using run-length encoding with length of one and zero runs. [1 mark]

(ii) How many bits are required to store the new representation? [1 mark]

(c) Answer the questions below using the image shown in Figure 4.1.

0	0	1	1
0	0	1	1
0	2	2	2
2	2	3	3

Figure 4.1

(i) Find the normalized co-occurrence matrices for the image using:
(1) $d = (0,1)$
(2) $d = (1,0)$

[2 marks]

(ii) Calculate and compare the contrasts of co-occurrence matrices in i(1) and i(2). [3 marks]

(iii) What does a contrast of 0 means? [1 mark]

Continued .....

QUESTION 5

(a) Explain the RANSAC algorithm. Use a pseudocode to illustrate the algorithm. [3 marks]

(b) Figure 5.1 to Figure 5.3 depict some frames extracted from a video sequence. The first image (Figure 5.1) is considered the reference, the second (Figure 5.2) depicts the same scene some time later, while the third (Figure 5.3) is the last frame in the video sequence. Your objective is to detect the moving person in the scene as illustrated in Figure 5.4.

(i) Explain the method you can use to detect the moving person in the scene. [2 marks]

(ii) Based on the answer in (i), what can you do to reveal the direction of the motion? [2 marks]

(iii) Is there any limitation associated with the proposed solution in (ii)? [1 mark]

Figure 5.1

Figure 5.2

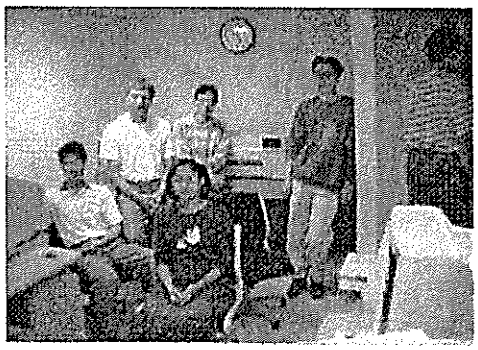


Figure 5.3

Figure 5.4

Continued .....

(c) The figure below shows the keypoints found by the SIFT (Scale-Invariant Feature Transform) descriptors. How well do you think the SIFT descriptors will still work if a set of brightness offset Δ values: $\Delta = -100,80,\ldots,80,100$ are applied on the image? [2 marks]

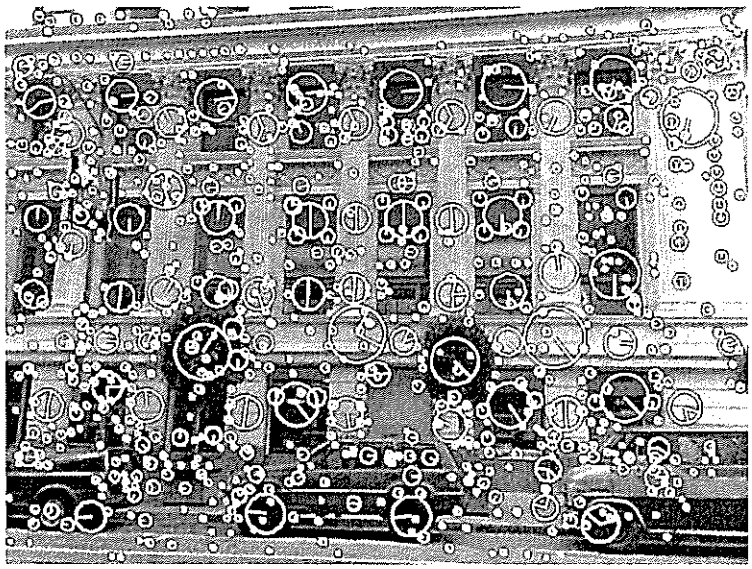


Figure 5.5

End of Page